COMPETITION AND QUALITY OUTCOMES IN THE HEALTH CARE MARKET: A BILATERAL ANALYSIS

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ABSTRACT

Micro-economic theory suggests both insurance market concentration and hospital market concentration may affect outcomes such as insurance premium and quality of care. Moreover, as concentration in the insurance market and hospital market may interact, it is impossible for economic theory to sign the impact. Using Healthcare Cost and Utilization Project (HCUP) Nationwide Inpatient Sample (NIS) 2007 data released by the Agency for Healthcare Research and Quality (AHRQ), this paper addresses the question empirically. Insurance and hospital market concentrations are measured by Herfindahl-Hirschman Index (HHI) and quality of care is measured by length of inpatient stay in days and probability of dying during hospitalization. To address the potential endogeneity problem, lagged values of both markets' HHIs are used as instrumental variables. The results of regressions on length of stay show that, generally, increases of insurance and hospital market concentration erode the quality of care, while the exact marginal impact of the structure of one market depends on the structure of the other. Study finds a positive correlation between monopoly-monopsony confrontation and quality of care in extreme cases but outcomes experienced by patients in such market are still worse than outcomes experienced by patients in competitive markets. Results about inpatient mobility are mixed. These findings suggest that, anti-competition trends in health care market should be closely monitored and regulated.

DEDICATION

This thesis is dedicated to my parents Min and Glen McIver and my grandparent Shuying He. Thank you for offering unending support throughout all my endeavors.

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INTRODUCTION

Increasing concentration in hospital and insurance markets is causing increased concern in the United States. According to the definition by Department of Justice (DOJ), a market with Herfindahl-Hirschman Index (HHI) greater than 2,000 is highly concentrated. And the American Medical Association (AMA) study shows that the average HHI of state insurance markets has been above 2,000 since 1999. As for the hospital market, observers worry that the accountable care organizations (ACO) endorsed by the Patient Protection and Affordable Care Act (PPACA) will beat other market players through cost savings, and that this will lead to further consolidation of the hospital market.

Intuitively speaking, concentration of hospital market should harm quality of care received by patients, as hospitals will be able to ask for higher payment for a given quality of care provided, while the effect of concentration in the insurance market is uncertain. Market power associated with high concentration in the insurance market may inflate premiums, since insurance companies will gain bargaining power relative to consumers. But, concentration in the insurance market may also drive premiums down or help to improve the quality of care, since hospitals will lose comparative bargaining power and be forced to lower prices or improve quality.

Sophisticated economic theories are not very helpful in this case. As products are differentiated and information is asymmetric in health care markets, complete competition assumptions do not hold. When hospitals can select quality to provide and negotiate price with insurance companies, economic theory fails to predict whether the effect of the market competition on outcomes will be positive or negative.

To sum up, given the fact that both hospital and insurance markets are increasingly concentrated, it is hard to anticipate, based on economic theories, the effect of this trend on the quality of care received by patients. Therefore, researchers try to estimate the effects of market competition using empirical analysis. As measures of outcomes, prices and quality of care interest the researchers the most. The literature records mixed results and most papers fail to take into account the interaction of the insurance market and the hospital market. Such research could be questionable, since without holding the impact of one market constant, it is difficult to isolate the effect of the other market on outcomes. To address this problem, this paper includes market concentration measures of both markets in its model specifications.

This paper is organized as follows. The background and literature section describes institutional background in more detail and reviews major research done in this area. The data section and methodology section introduce the datasets and models. The results section contains my analyses of the relationship between concentration and quality of care. The last two sections discuss policy implications and directions for future research.

INSTITUTIONAL BACKGROUND

The health care system in the United States is characterized by increasing costs, limited access and uneven quality. In 2009, topping the list of OECD (Organisation for Economic Co-operation and Development) countries (OECD 2011), the U.S. spent 17.4% of its GDP on health care. However, the outcomes produced were unsatisfactory. In 2011, 40.3 million nonelderly adults and 7.6 million children were uninsured (Kaiser Family Foundation 2012) and the United States falls behind other developed countries in several quality indicators including efficiency, safety, and coordination.

In addition, rather than being the free market preferred by people in this country, the health care market is highly concentrated. Over the past twenty years, the market for hospital care witnessed increased concentration, as a substantial number of hospitals have merged. (Gaynor and Haas-Wilson 1999) In 2006, the state mean HHI for hospital markets was 3,261 in 2006, much greater than the 2,000, the old threshold of highly concentrated markets defined by DOJ. The same is true for insurance market. Under the new guidelines issued by DOJ and Federal Trade Commission (FTC) in August 2010, more than 300 insurance markets in metropolitan areas out of the 368 studied were highly concentrated with HHI greater than 2,500. (AMA 2011) Furthermore, rather than leaving associated with quality of care, there is evidence that the change of price in health care market is associated with market power. (Gaynor and Town 2012) This evidence implies that, compared with competitive markets, consumers in concentrated markets might need to pay more for the same quality or quantity of care received. Though the problem of market concentration has concerned the U.S. healthcare for a long time, there is no signal that the problem will be addressed in the near future. Actually, the new legislation may aggregate the problem.

In March 2010, with tremendous efforts over many years to solve the problems of access, cost and quality, Patient the Protection and Affordable Care Act (PPACA) was passed. The Act encourages application of a new payment model, the Accountable Care Organization (ACO) under Medicare, providing an opportunity for a major reorganization of the U.S. health care delivery system. (Greaney 2011) Unlike all the other market players, the ACO model makes providers, such as health care professionals and hospitals, accountable for the quality and the cost of the care. (Devers and Berenson 2009) ACOs are designed to be provider-lead organizations that receive payments based on quality improvement through coordination and cost savings. (McClellan et al. 2010). After generous insurance payment in the 1950s-1960s, a medical arms race later on, and the prevalence of but also the backlash against Health Maintenance Organizations (HMOs) in the 1990s, the ACO is expected to lead health care delivery system of the United States into a forth regime, where providers including primary care physicians, specialists, hospitals and post-acute care facilities team up and perform as an integrated team to compete on the basis of quality of care. Proponents believe that, by promoting internal experience sharing and reducing production inefficiencies, ACOs may outcompete other providers and grow to be powerful market players; while opponents express concern about the consequence of increased market concentration. With pilot programs fostered by the PPACA under Medicare and increasing interests among private players, as of 2012, more than 200 self-identified ACOs has been established across the United States. (The Engelberg Center for Health Care Reform at Brookings and the Dartmouth Institute 2012)

But increasing concentration in the hospital market might not necessarily lead to erosion of care quality. It is possible that the market power of some insurers will partially cancel out that of providers so that cost will be contained and quality of care secured. It is also possible, as AMA advocates, that the concentration in insurance market will put the physicians at disadvantage forcing them to accept reimbursements lower than what is fair, thus undermining the quality of care provided by physicians. (AMA 2012) However, neither theoretical nor empirical research has yet provided evidence to support the concern.

To sum up, given current trends in the insurance and the hospital markets, a major question in the current policy context is what the relationship is between concentration in health care markets and outcomes produced by the system.

LITERATURE REVIEW

A rich literature models and examines the effect of market competition on outcomes. In the case of health care markets, as noted above, it is impossible to sign the impact of market concentration on change of price or quality theoretically, and empirical studies record mixed results.

Generally, the literature in this area can be divided into two groups in terms of research subjects. One group studies the relationship between concentration in the insurance market and outcomes, with most papers in this group using price and quality of care as measures of outcomes, and premiums, price dispersion, search cost, demand elasticity or welfare to measure price. (Dafny 2012, Bolhaar et al. 2010, Starc 2010) Studies in this area generally find that consolidation of insurers, the vertical integration among insurers and providers, and monopsony power increase prices (Gaynor and Town 2012). However, studies focusing on the insurance market rarely examine effect of concentration on quality. In contrast, the second group of studies looks at the relationship between hospital market concentration and quality of care. Major empirical papers in this field use mortality, readmission rates, and other quality indicators to measure quality of care. In both groups, typical measure of market concentration is HHI. Some researchers in the latter also group use number of hospitals. HHI is usually defined as sum of square of each firm's market share. In general, researchers report mixed results. (Gaynor and Town 2012) More details about the above research are described below.

Competition of Insurers and Monopsony Power

Based on their study of the 1999 merger of Aetna and Prudential, Dafny et al. (2012) concludes that increases in concentration do raise premiums. Consistent with the findings of Dafny et al. (2012), Starc (2010) models the Medigap market and documents a positive relationship between premiums and market concentration. In addition, they discuss monopsony power as the product of extreme cases resulted from insurance market concentration. Monopsony affects the costs of health care provision in that the bargaining leverage of insurers lowers provider prices. However, evidence of monopsony in health care markets is quite limited. (Gaynor and Town 2012) Also these articles neither take competition of hospitals into account, nor evaluate quality as outcome.

Competition of Hospitals

Another cluster of studies concern the relation between hospital market concentration and outcomes. Researchers use the HHI to measure market concentration in their models or do analysis on hospital mergers. Outcomes are measured in terms of either price or quality of care. The most commonly used measure of quality is mortality. (Gaynor and Town 2012) With regard to method, many empirical studies in this field employ reduced form "Structure-Conduct-Performance" (SCP) models, others adopt structural methods.

One of the most cited articles in this group is by Kessler and McClellan (2000). Using Medicare inpatient data and the SCP framework, Kessler and McClellan attempts to make inferences about a causal effect of competition measured by HHI on the quality of hospital care measured by risk-adjusted one-year mortality from heart attack. They find that mortality is significantly and positively correlated with market concentration. This finding implies that increased hospital market consolidation erodes quality. However, Gowrisankaran and Town (2003), using Los Angeles Medicare inpatient data, the same measure of hospital competition, and the same SCP framework, find negative correlation between market concentration and quality.

In addition to studies on the hospital market where price is formulated by public payers, many other papers examine competition and quality in another part of hospital market where market determines price. For example, the above mentioned paper by Gowrisankaran and Town (2003) includes a section about the health maintenance organizations (HMO) and the findings that competition increases quality through reduced mortality. This result is consistent with other papers using similar measures (Sohn and Rathouz 2003). Other researchers employ patient safety indicators rather than risk-adjusted mortality as a quality measure, Encinosa and Bernard (2005) and Sari (2002), for example, find that competition has a positive effect on the quality of care in their research. Additionally, researchers using different measures also find a positive relation between competition and quality. For example, Howard (2005) who uses graft failure as outcome measure and demand elasticity as market structure measure together with Abraham et al. (2007) who use quantity of care consumed and number of hospital respectively all find positive correlations.

But, not all the papers document similar results. Using California mortality and HHI data, Mukamel et al. (2002), for example, find that competition decreases quality. So does Propper et al. (2004) and Burgess et al. (2008). The latter use a dataset containing patients suffering from heart attacks in the UK, measure quality by mortality, and measure market concentration by number of competitors.

Other than these two groups of articles which find either positive or negative relation between market concentration and quality, a study by Hamilton and Ho (2000) shows no effect of competition on quality. The two researchers compare hospital quality indicators including mortality, readmission and early discharge before and after mergers and acquisitions in California between 1992 and 1995. They find hardly any measureable impact of concentration on mortality, though readmission rates and early discharge increased in some cases. Based on the evidence they collect, they conclude that fears about adverse consequences for quality of increased providers' market power for quality are unsubstantiated.

In addition, Escarce et al. (2006), Rogowski et al. (2007), Mutter et al. (2008, 2011), and Romano and Balan (2011) observe conflicting results in their own researches. Escarce et al. (2006) extent the research by including patients with both acute diseases including heart attack, hip fracture, stroke, and those with chronic conditions, such as diabetes in California, New York and Wisconsin. The authors find that only patients in California suffer decreased quality when hospital concentration increased. They found no effect in the other two places. Rogowski et al. (2007) who also do a research on several conditions find mixed results by conditions. In their analyses, higher competition is associated with higher quality for conditions including CVA (Cerebral Vascular Accident), GIH (Gastrointestinal Hemorrhage), CHF (Congestive Heart

Failure), and diabetes. But contrasting results are found among patients with acute myocardial infarction in public hospitals and those with stroke, GIH, and diabetes in major teaching hospitals.

In summary, the results of empirical studies are not uniform. On one hand, according to Sloan (2012), existing research indicates that the bargaining power of hospitals is essential to answer the question of whether competition among hospitals does or does not increase quality. On the other hand, Gaynor and Town believe that future research on this topic should sort out the determinants associates with competition that have an impact on quality. In addition, to perform normative and further empirical analysis, researchers need more detailed models recovering preferences and costs. Generally, health economists believe the effect of competition in hospital markets depends on the precise mix of payers, the relationship between level of payment and cost of treatment, and variety in the severity of patients. (Propper and Leckie 2010). Some of these particulars, such as severity of patients are controlled in the studies mentioned above, but others fail to attract enough attention.

Bilateral Studies

Despite the results, papers focused on either insurance or hospital market mentioned above fall into the category of unilateral analysis. The long history of the discussion about the relationship between hospital market structure and quality of care implies that the interaction between insurers and hospitals may be important. Because of differentiated products, imperfect information, and extensive government regulation, the health care market is different from a perfectly competitive market. The conventional wisdom once was that non-health professionals are unable to judge the quality of care. Therefore patients' preferences are neglected and competition is considered unseemly. (Sloan 2012) However, the medical arm race that started in the 1980s changed the argument. In that period, hospitals invested heavily in equipment and technology in order to secure their market shares in a competitive market. Propper and Leckie (2010) believe the medical arm race resulted from generous payments from insurance companies. In this circumstance, hospitals competed on the basis of quality and drove up both cost and quality. (Propper 2010) After the Prospective Payment System (PPS) was introduced, however, question arose about whether PPS reduced quality or not is still unsettled as studies show mixed results. (Propper 2010) Then, in the third regime when HMOs emerged and grew in the market, researchers started to examine the impact of this new insurance model on quality. They argued that compared with Medicare, HMOs reduced cost and improved quality, as they competed with each other, paid a decent rate for treatments, and encouraged hospitals to compete on quality. Empirical studies are done to test those arguments; however, their results are not consistent. Considering the potentially opposite but also related market power of the two markets, ignoring one market in an analysis of the concentration of the other may bias the results.

Gaynor and Town (2012) develop mathematic model of price bargaining process between hospitals and insurers. This model assumes that hospital can freely choose quality of care to provide, and the model is unable to sign the impact of market concentration on quality.

Empirical studies on vertical integration are usually bilateral. Gal-Or (1997, 1999) includes both hospitals and insurers in his model and describes the reactions of providers and payers to market concentration of the other party. He concludes that, hospitals are more likely to enhance efficiency through merging when the payers' market is highly concentrated, but for efficiency reasons insurers are less likely to do so when the concentration of the providers market is high. Gal-Or also finds consumers enjoy greater welfare if insurers and hospitals pair up exclusively. However, his study is at the consumer level, instead of the patient discharge level. Outcomes studied in his paper are measured by consumers' utility rather than quality of care. Additionally, he ignores some hospital characteristics (Ho 2009).

One of the few empirical studies that investigate the bargaining process between insurers and hospitals, by Halbersma et al. (2010) uses 2005-2006 data from Netherlands, where market-oriented reform was introduced in 2004. Key variables in the SCP model employed in this study include hospital price mark-up and the HHIs of both the hospital and insurance markets. Controlling for market shares and the size of both parties, regression results show that, compared with the situation in markets where price is administrated, market structure has a significant but weak impact on profit margin of hospitals where price is determined by the market. The authors also construct a model based on the Harsanyi-Nash-Zeuthen bargaining model to identify the share of gain hospitals receive in relation to the total gain generated by providing health care to consumers. Estimation of this model implies that concentration of the insurers market significantly increases the share of gain enjoyed by insurers, but concentration in hospitals market has no significant effect on the share that hospitals receive. The results of this article are important for the U.S. system, as it implies that ACOs may decrease competition among providers but may not lead to deteriorated quality. They also suggest that, to control the soaring premiums of health insurance, policymakers should foster competition among insurers. Halbersma et al. (2010) suggest that the direction for future research should be analysis of patient-level data, controlling for patient characteristics.

Following the direction established by the previous literature, this paper uses patient-level data and controls for both patient characteristics and hospital characteristics. In addition, the paper would like to employ quality indicators rather than price to reflect the effect of market power on patients. Because products traded in the health care market are differentiated, and price is the not the best or most convincing measure of outcome. (Sloan 2012)

This paper contributes to the current literature by extending the study of Halbersma et al. (2010) concerning Netherlands to the health care market of United States. Unlike most of the previous studies, which focus on unilateral market power of insurers or hospitals, this paper investigates the market concentration of both parties at the same time. This paper also contributes to the literature in that it uses quality of care instead of price as measure of outcome in a model that includes both insurance and hospital market concentration. It also uses most recent national-wide inpatient data, while most prior studies use regional data of the late 1990s and the early 2000s.

However, further research on this topic is needed in the sense that the quality indicators used in this paper are not the only and the most precise measures of health care quality. HCUP Patient Safety Indicators, 30-day readmission and 30-day mortality are good alternatives as quality measures. Furthermore, if researcher could leverage longitudinal data, they might obtain more robust conclusion. Weakness of the paper will be failure to control for the relative bargaining power of each hospital and insurance company. Instead of relying on the HHI of the entire market, we might learn more by looking at the comparative market power of each market players. Absolute market share may not matter as much as a firm's market shares relative to its competitors. In an extreme case, the HHI of two markets could be similar, but a firm with 50%

market share and a single competitor controlling the other half of the market, may have less bargaining power than a firm with 20% market share in a market where the other firms only have 10% market share each. However, lacking data, I have been unable to link the patient to a particular insurance company and control for characteristics of the related health care plan. Omitting the market share of the insurance company may cause an upwards bias of the estimate, since we expect the market share of a single company to be positively related with the concentration of the insurance market and consequently positively correlated with the outcomes we are looking at.

DATA

Data on health care outcomes in my analysis come from Healthcare Cost and Utilization Project (HCUP) National Inpatient Sample (NIS) 2007 data released by AHRQ. HCUP NIS 2007 data contains information of 8.043 million hospital discharges in the year of 2007, from 1,044 hospitals in all 40 HCUP participating states. For convenience, I use 25% random subset of the HCUP NIS data. Quality is measured by length of stay (LOS) and inpatient mortality (DIED). LOS is a continuous variable measuring patients' hospital stay in days. Inpatient mortality, DIED, is a binary variable, which equals one if the patient died during the stay, or equals zero if he did not. Insurance market HHI data are compiled by the AMA every year. 2007 (Dafny 2011) and 2005 (AMA 2007) data in state level are now publicly available. Hospital market HHIs come from the HCUP Hospital Market Structure (HMS) Files by AHRQ. County level market structure data are collected very three years to supplement HCUP data. I choose to use the HMS file for the year 2006, since the 2006 data matches the 2007 patient discharge data the most closely in terms of time. I use data included in the 2003 file as instrumental variable. HHI indexes are usually 4-digit values. In my dataset, both HHIs are divided by 10,000 to make sure the coefficients of the regression results are manageable. This means HHIs in my dataset are values between 0 and 1. Additionally, states included in HCUP NIS 2007, HMS files and AMA data do not completely overlap.

Key variables are LOS, DIED and HHIs. I examine the distributions of the key variables in order to figure out the proper functional forms for my analysis. Figure 1 and Figure 2 show the distribution of variables LOS, HHI of hospitals market and HHI of insurance market. While the distribution of LOS is clearly skewed, the patterns of the HHIs are not clear. The characteristics of hospitals and patients are controlled. Table 1 describes the variables in detail, and Table 2-4 show descriptive statistics for the variables. I exclude the variable race here, since about one third of the HCUP participating states didn’t collect race data in 2007. Including race in regressions will exclude substantive proportion of patients discharge cases from samples for these states.

Figure 1: Distribution of LOS

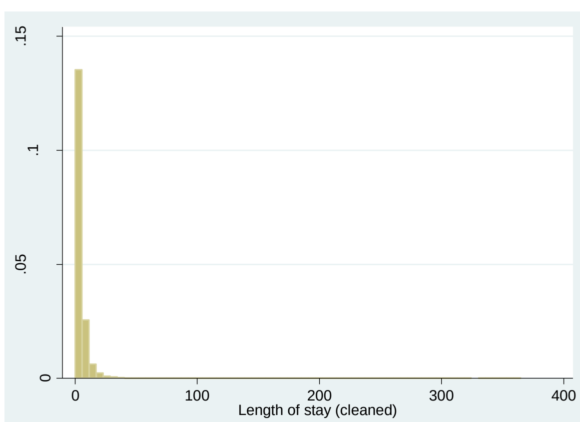
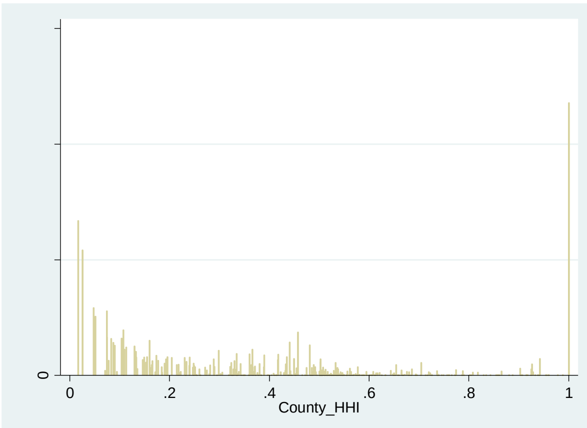


Figure 2: Distribution of HHI



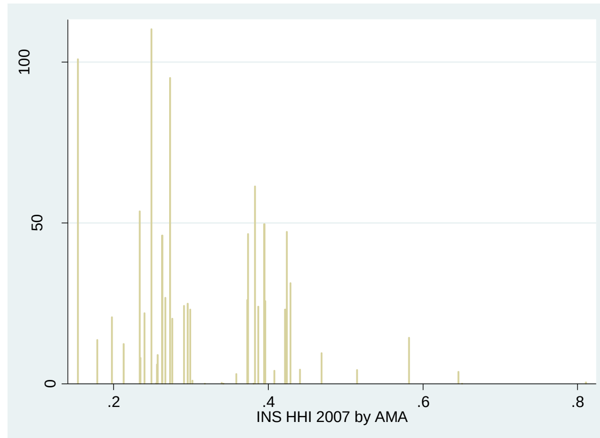


Table 1: Variable List

Name of Var	Description	Type
LOS	Indicates the patients' stay in hospital by days.	Continuous.
DIED	Indicates that whether a patient dies in-hospital, this variable measures in-patient mortality.	Discrete.
HMS_HHI2006	This variable measures HHI in hospital market defined by Health Service Areas (HSA) in the year of 2006.	Continuous.
INS_HHI2007	This variable measures HHI in insurance market defined by state in the year of 2007.	Continuous.
HMS_HHI2003	This variable measures HHI in hospital market defined by Health Service Areas (HSA) in the year of 2003.	Continuous.
INS_HHI2005	This variable measures HHI in insurance market defined by state in the year of 2005.	Continuous.
AGE	This variable indicates the age of the patient at admission. Age in years coded 0-124 years.	Continuous.
FEMALE	This variable indicates gender of the patient. (0) male, (1) female	Discrete.
ADMISSION_TYPE	This variable indicates admission type. (1) emergency, (2) urgent, (3) elective, (4) newborn, (5) Delivery (coded in 1988-1997 data only), (5) trauma center beginning in 2003 data, (6) other	Discrete.
URBAN	This variable indicates location of the patient. Developed based on NCHS Urban-Rural Code (V2006), this is a six-category urban-rural classification scheme for U.S. counties	Discrete.
INCOME	This variable indicates median household income for patient's ZIP Code. It is divided into four quartiles for patient's ZIP Code for 2007.	Discrete.
HOSP_BEDSIZE	This variable measures size of the hospital by bed size.	Discrete.
HOSP_CONTROL	The Control/ownership of hospital variable indicates ownership of the hospital.	Discrete.
HOSP_TEACH	This variable indicates teaching status of hospital.	Discrete.
HOSP_LOCATION	This variable indicates urban/rural designation of hospital.	Discrete.

Table 2: Descriptive statistics for dependent variables

Variable	Level	Obs.	Mean	Std. Dev.	Min	Max
DIED	Patient Discharge	2008060	0.019364	0.137801	0	1
LOS	Patient Discharge	2008389	4.568742	6.872655	0	365

Table 3: Descriptive statistics of independent variables and instrumental variables

Variable	Level	Obs.	Mean	Std. Dev.	Min	Max
INS_HHI2007	State	1693810	0.304744	0.095569	0.15	0.81
HMS_HHI2006	County	1155953	0.341943	0.310048	0.02	1

Table 4: Descriptive statistics for control variables

Variable	Obs.	Mean	Std. Dev.	Min	Max
age	2006316	47.04256	28.17951	0	114
female	2002572	0.589018	0.492012	0	1
admission_type	1768728	2.032439	1.087109	1	6
payer	2004087	2.250203	1.214198	1	6
urban	1948798	2.696908	1.604861	1	6
income	1954688	2.364958	1.123516	1	4
hosp_bedsize	2005719	2.489741	0.722801	1	3
hosp_control	2005719	0.929281	1.252835	0	4
hosp_location	2005719	0.869293	0.337079	0	1
hosp_teach	2005719	0.467868	0.498967	0	1

METHODOLOGY

I use a reduced form of Structure-Conduct-Performance (SCP) model to estimate effects. The reduced form approach to estimate effects of concentration is commonly used in the industrial origination and health economics literature. Studies of quality simply use a quality indicator as the measure of performance. (Gaynor and Town, 2012) For instance, Sari (2002) uses a SCP model and replaces price with HCUP quality indicators (QIs) as dependent variables. A basic SCP model can be formulated as follow:

$$P_i = f(M_i, D_i, C_i) \qquad \text{Equation 1}$$

where P_i is a performance measure, M_i is a set of market structure variables, D_i is a set of demand shifters, and C_i is a set of firm/product-specific control variables. In relation to the impact of market concentration on quality, P_i is a quality indicator, M_i are market concentration indicators for health insurance market and hospital market respectively. The Herfindahl-Hirschman Index (HHI) is one of the most frequently used measures of market competition. Its simplest form is $HHI = \sum_{i=1}^{n} MS_i^2$, where MS_i^2 is square of a single organization's market share. n is number of firms in the market. D_i is a set of variables related to demand for health care services and insurance policies from hospitals and insurance companies. The income of consumers is one of demand shifters, and C_i is a set of variables related to health care supply. Characteristics of hospitals could be considered as supply shifter in this case. In addition, I will control for patients characteristics W_i, when I estimate the model. An equation for the basic SCP-model to be estimated could be written as follows:

$$Q_{ij} = \beta_1 HHI_{insi} + \beta_2 HHI_{hi} + \beta_3 D_i + \beta_4 C_i + \beta_5 W_i + \varepsilon \qquad \text{Equation 2}$$

where Q_{ij} is a quality indicator of patient *i* discharged by hospital j, HHI_{insi} measures the market concentration of insurers at state level, and HHI_{hi} measures the market concentration of hospitals in county level.

Though the reduced form SCP model is widely used, it suffers from three major disadvantages. First, the relationship between HHI and performance is only held with a Cournot behavior-quantity setting, in which scenario the products are homogeneous. In the health care market, products are differentiated, though. Moriya et al. (2010) consider this concern not applicable to analysis of bilateral oligopoly. Second, researchers have many concerns about the endogeneity problem associated with using HHI in the model. The current market structure might be related to omitted variables that cause changes of quality or might be caused by the changes of quality reversely. In the first case, the more powerful an entity is the higher price it may be able to ask. In this case, it is highly possible that some unobservable variables affect both quality of care and market structure. For example, the managerial skill of executives, which is hard to observe and measure, might be correlated with both quality and market structure. If a hospital or an insurance company hires executives with stronger managerial skills, the executives might improve quality of care and seize larger market shares at the same time. As a result, quality of care increases and HHI is inflated, but there is no causal relation between the simultaneous changes. As for the latter circumstance, in our quality-market structure context, it is entirely possible that hospitals or insurance companies that provide better health care services gain larger market shares and consequently increase the HHI indicator of this area. Third, geopolitical boundary is not a good indicator to link patients with the hospital market. Distance between the patients home and the hospital may serve as a better indicator, but these data are not included in HCUP. To remedy the endogeneity problem mentioned above, I use an IV regression. The equation is then written as follow.

$$\ln Q_{ij} = \beta_1 \ln \widehat{HHI}_{insi} + \beta_2 \ln \widehat{HHI}_{hi} + \beta_3 \ln D_i + \beta_4 \ln C_i + \beta_5 \ln W_i + \varepsilon \quad \text{Equation 3}$$

The log-log form is employed here since it is common practice in SCP analysis (Halbersma 2010) but some authors (Sari 2002) convert the values into their logarithmic form just because they observe that the sample distribution is skewed. Sari (2002) and Dafny (2012) both estimate the equation without converting HHI variables into its logarithmic form. In this study, I will transfer variables that are skewed, but keep those binary variables and continuous variables with unclear distributive pattern unchanged.

With regard to instrumental variables, Halbersma et al. (2010) indicate that lagged values of HHI could serve as a proper instrument to fix the endogeneity problem. Hence, lagged HHIs in both hospital market and insurance market are introduced as instrumental variables in my first-stage regression models. The equations have the following appearance:

$$\ln \widehat{HHI}_{insi} = \alpha_1 \ln HHI_{insi(t-1)} + \alpha_2 \ln C_i + \alpha_3 \ln D_i + \alpha_4 \ln W_i + \varepsilon$$

$$\ln \widehat{HHI}_{hi} = \theta_1 \ln HHI_{hi(t-1)} + \theta_2 \ln C_i + \theta_3 \ln D_i + \theta_4 \ln W_i + \varepsilon \quad \text{Equation 4}$$

I expect the lagged values of market structure as instrumental variables to peel off unrelated variance and give me a causal relation between P_i and M_i. The lagged HHI could serve to solve the endogeneity problem in the sense that it will be closely correlated with its current value, but can only affect the current outcome through its current value. Even though the relation between market structures and outcomes may be persistent over time, it is likely that outcomes are more closely correlated to current values of an HHI than with its lagged values. One problem of using lagged HHIs is to decide that how long the lags need to be. Longer lags may be stronger in reducing correlation between the instrument and the error term of the second-stage ordinary least squares (OLS) regression, but may also be weaker in terms of correlation with the current HHIs. In addition, lagged HHIs might not be valid instruments due to endogeneity as well. I test the correlation between the lagged HHI and current HHI in my first-stage regression to determine whether the instrumental variables are relevant, and I run over-identification test for exogeneity.

In addition, for reasons including that hospitals compete on quality to be included in the insurers' network and also negotiate with insurance companies over reimbursement rates they receive for treatment of enrollees, I believe that insurance and hospital markets interact with each other. The hospitals have free choices about the quality of care they can provide, and they will trade off quality for profit if rates are controlled by insurance companies. As a result, the interaction of market concentration may have an impact on quality of care through affecting bargaining power of the players in the market. Additionally, the relation between HHI and quality of care measured by length of stay might not be linear. Therefore, I add both an interaction term and two quadratic terms into the estimation model.

In summary, I employ simple OLS specification and two-stage OLS IV regression to identify the relationship between market concentration and quality. Based on all the discussion above about research model, functional form, and identification methods, my specification equations are structured as follows.

Simple OLS model (Equation 5):

$$Q_{ij} = \alpha + \beta_1 INS\_HHI_{2007} + \beta_2 MHS\_HHI_{2006} + \beta_3 INS\_HHI_{2007}{}^2 + \beta_4 MHS\_HHI_{2006}{}^2 + \beta_5 INS\_HHI_{2007} * HMS\_HHI_{2006} + \beta_6 Female + \beta_7 \text{Age} + \beta_8 Admission_{Type} + \beta_9 Payer + \beta_{10} Urban + \beta_{11} Income + \beta_{12} Hosp\_bedsize + \beta_{12} Hosp\_control + \beta_{13} Hosp\_location + \beta_{14} Hosp\_teach + \varepsilon$$

Two-stage IV regression First-stage (Equation 6):

$$INS\_\widehat{HHI}_{2007} = \alpha_0 + \alpha_1 INS\_HHI_{2005} + \alpha_2 HMS\_HHI_{2003} + \alpha_3 INS\_HHI_{2005} * HMS_{HHI_{2003}} + \alpha_4 Female + \alpha_5 \text{Age} + \alpha_6 Admission_{Type} + \alpha_7 Payer + \alpha_8 Urban + \alpha_9 Income + \alpha_{10} Hosp\_bedsize + \alpha_{11} Hosp\_control + \alpha_{12} Hosp\_location + \alpha_{13} Hosp\_teach + \varepsilon$$

$$\widehat{HMS\_HHI}_{2006} = \theta_0 + \theta_1 INS\_HHI_{2005} + \theta_2 HMS\_HHI_{2003} + \theta_3 INS\_HHI_{2005} * HMS_{HHI_{2003}} + \theta_4 Female + \theta_5 \text{Age} + \theta_6 Admission_{Type} + \theta_7 Payer + \theta_8 Urban + \theta_9 Income + \theta_{10} Hosp\_bedsize + \theta_{11} Hosp\_control + \theta_{12} Hosp\_location + \theta_{13} Hosp\_teach + \varepsilon$$

Second Stage:

$$Q_{ij} = \alpha + \beta_1 \widehat{INS\_HHI}_{2007} + \beta_2 \widehat{HMS\_HHI}_{2006} + \beta_3 INS\_HHI_{2007}{}^2 + \beta_4 MHS\_HHI_{2006}{}^2 + \beta_5 INS\_HHI_{2007} * HMS\_HHI_{2006} + \beta_6 Female + \beta_7 \text{Age} + \beta_8 Admission_{Type} + \beta_9 Payer + \beta_{10} Urban + \beta_{11} Income + \beta_{12} Hosp\_bedsize + \beta_{12} Hosp\_control + \beta_{13} Hosp\_location + \beta_{14} Hosp\_teach + \varepsilon$$

Q_{ij} are outcomes measured by length of stay (LnLOS) and inpatient mortality (DIED) at the patient discharge level. For demand shifters, D_i, I include median household income of the area where the patient is from. The market share of the hospital and the insurer are all important demand shifters. As I failed to locate data to control for that, I will refer to Halbersma (2010) and Sari (2002) for the effect of this omitted variable bias. Variables in the C_i category are teaching status, bed size, and location. I will also take hospital ownership type into account, as it might bias the estimates (Bayindir 2012). W_i is a set of other control variables such as patients' sex, age, primary payer, urban, and admission type.

In the second stage regression on quality measures, all the control variables in the first stage regressions are controlled. For the binary dependent variable inpatient mortality (DIED), I run IV Probit model together with a two-stage OLS model and compare the results. I apply log transfer to the continuous dependent variable length of stay (LOS), as it is highly skewed with an average value of 4.57 days but maximum of 365 days. Figure 1 above displays the distribution. As the pattern of HHI distributions are not clearly skewed and the control variables are all categorical variables, I keep them in their original form. I add an interaction term of lagged HHIs in the IV regressions in order to test whether the instrumental variables are valid.

RESULTS

Generally I expect to observe positive results for interaction term of hospital market HHI and insurance market HHI, while signs of each HHI are hard to anticipate. Due to concentrated hospital markets, hospitals may lower their quality given predetermined reimbursement rates leveraging their market power. But with a (set of) major insurer(s) controlling the local market, as the price is set by payers, hospitals may be forced to compete on quality. However, there are also reasons that lead me to believe a different story in which insurance companies in a monopoly position reduce reimbursements so much that it hurt quality while hospitals merge to improve quality. I expect that the higher the market concentration of hospital is associated with higher quality for three reasons. First, a large number of low-volume inefficiently small providers will create inefficiency (Sloan 2012). Second market concentration also empowers the hospitals to negotiate for a reasonable reimbursement from payers in order to maintain quality and keep on investing to improve it. Third, lots of evidences have been presented in the volume-outcome research that larger volumes of medical procedure are associated with better quality. Since hospital mergers improve efficiency and facilitates specialization, hospital market concentration is expected to be positively related to quality improvement. Despite which version of the story is true, assessing the effects of hospital and insurance market HHI together in a single analysis, I expect to observe counterbalanced market powers. I believe that, these effects may cancel each other out and result in a second best scenario. Compared with a situation where only one market is concentrated, the system as a whole delivers better quality of care, under this scenario. Taking advantage of countervailing power, markets characterized by monopsony-monopoly confrontation can sometimes lead to more efficient output.

However, though I find evidence that counterbalanced market power exists, I observe unexpected results concerning the relationship between separate market structure and quality. To understand these findings, I will first look at the OLS regression result and compare them with the results regenerated from IV regression and provide possible explanation of such similarities or differences.

DOES CONCENTRATION LEADS TO A LESS GENEROUS LENGTH OF STAY? IT DEPENDS

The OLS regression shows that concentration in the insurance market is associated with a longer length of stay in the hospital, while concentration in the hospital market is associated with a decreased length of stay. An increase of HHI from 0 to 1 in insurance market and hospital market are associated with 12% increase and 11% decrease of LOS respectively. Both coefficients are significant at 0.01 level. Coefficients of key variables, levels of significant and related standard error are included in Table 5, while a full list of all the coefficients of variables in the models can be found in the Appendix.

As both HHI variables are index values between 0 and 1, a one unit increase of the HHI variables might not make sense in terms of understanding the size of correlation. Thus, I conduct a scenario analysis to better understand the size of the correlation between market structure and quality of care. Among all patients older than 65, the average age is about 77. Suppose there is a male patient who is about 77 years old, having Medicare as his primary payer, living in the low income area (with median household income equal to or less than $38,999) of a central county in metro areas (a county has more than 1 million in population). He is admitted to the emergency room of a small non-teaching public hospital. If this county has very competitive insurance and hospital markets with both HHI values falling into the bottom 5 percentile, he is expected to stay in the hospital for about 3.9 days; while if this county has concentrated markets with both HHI values falling into the top 5 percentile, he is expected to stay for about 3.6 days. Table 6 shows the value I plug in to calculate the length of stay under different scenarios.

Table 5: Estimated Coeff. of LnLOS under different models

Estimated Coeff.												
Ln of Length of Stay	**OLS**			**OLS with both interaction and quadratic term**			**2-stage IV regression with interaction terms**			**2-stage IV regression private plan**		
	Coeff.		**s.e.**	**Coeff.**		**s.e.**	**Coeff.**		**s.e.**	**Coeff.**		**s.e.**
INS_HHI2007	0.1205	*	0.0104	-0.3380	*	0.0657	-14.5364	*	0.7183	-0.5584	*	0.0278
HMS_HHI2006	-0.1077	*	0.0040	-0.3224	*	0.0155	-0.5359	*	0.0217	-0.4693	*	0.0152
INS_HHI2007^2				0.4725	*	0.0919	19.9809	*	0.9966			
HMS_HHI2006^2				0.1380	*	0.0113	0.6152	*	0.0223			
INS*HMS				0.2133	*	0.0312	-0.7649	*	0.0749	1.1123	*	0.0464
Control variables							……					
Intercept	0.9321	*	0.0088	1.0452	*	0.0150	3.6926	*	0.1305	1.0875	*	0.0119
number of obs.	776801			776801			679103			679103		
R-square	0.0809			0.0812			0.0332			0.0774		
Instruments	N/A			N/A			INS, HMS, INSHMS			INS, HMS, INSHMS		

* significant at 0.01 level, ** significant at 0.05 level.

Table 6: Value of HHIs in Percentile

Value of HHIs in percentile					
Variable	**Obs**	**Percentile**	**Centile**	**[95% Conf. Interval]**	
HMS_HHI2006	1155953	5	0.0165	0.0165	0.0165
		50	0.2397	0.2397	0.2397
		95	1.0000	1.0000	1.0000
INS_HHI2007	1693810	5	0.1540	0.1540	0.1540
		50	0.2730	0.2730	0.2730
		95	0.4290	0.4290	0.4290

When interaction terms and quadratic terms are added, the fitness of the model barely improves. The R-square increases from 0.0809 to 0.0812. Though the improvement of fitness is minor, I keep these terms in the model as the coefficients are statistically significant at the 0.01 level. In this model, I find that the coefficient of hospital HHI remains negative, while the coefficient of insurance HHI changes sign. Concentration in both the insurance and hospital markets is associated with negative an impact on length of stay. But taking quadratic terms and interaction terms into account, the results are more complicated. The impact of insurance concentration on quality of care is a function of hospital market concentration, and *vice versa*. From the following equation we can see that the relation between insurance market concentration and quality is: $\Delta = \beta_1 + \beta_3 + \beta_5 * HMS\_HHI2006$, and $\Delta = \beta_2 + \beta_4 + \beta_5 * INS\_HHI2007$ for hospital market concentration. As for insurance market concentration, a one unit change of INS_HHI is correlated with a (-0.3380+0.4725+0.2133*HMS_HHI2006) unit change of quality. As HMS_HHI2006 is greater than zero, the figure is always greater than zero, which is comparable with the results yielded by the simplest OLS estimation. With regard to hospital market concentration, a one unit change of HMS_HHI is correlated with a (-0.3224+0.1380+0.2133*INS_HHI2007) unit change of quality. When INS_HHI is greater than 0.8726 this figure is positive, while in competitive markets, the figure is negative. As the maximum value of INS_HHI2007 is 0.81, the correlation between hospital market concentration and quality in reality is always negative. The interaction term is significant at the 0.01 level, which means "impact" of concentration in the insurance market changes in accordance in the changes in the hospital market and *vice versa*. The positive value of the coefficient of the interaction term demonstrates that the interactive effect between opposite market powers is positively correlated with outcomes. Additionally, I find that with extremely high insurance market consolidation, hospital concentration is good for quality of care. In that sense, the monopsony-monopoly confrontation does lead to positive marginal effect in this case. Estimated by this model, for the same patient described above, his inpatient stay will be 4 days in a competitive area versus 3.6 days in an area with highly consolidated markets.

I then run a two-stage OLS model on the variable LOS. The results show that insurance market concentration is positively correlated with LOS while hospital concentration is associated with a decrease of LOS (both significant at the 0.01 level) respectively. Taking the same patient as an example, he can stay in the hospital for 8.25 days in an area with competitive markets, but for only 2.94 days (for the same condition) if he lives in a highly consolidated health care market. The first stage results demonstrate two F-statistics greater than 10 and significant at 0.01 level, which shows high relevance between the instrumental variables and the instrumented variables. The model also passes a Hausman-Test with a P-value of 20.68 significant at 0.01 level, which means the model with IV added is significantly different from the original model. However, the model does not pass the over-identification test, which means the lagged HHIs might be endogenous therefore not valid. The Sargan (score) Chi-square is 160.362 (p = 0.0000) and the Basmann (score) Chi-square is 160.392 (p = 0.0000). Both P-values are less than the 0.1threshold.

In short, it is generally better to have competitive insurance and hospital market at the same time, though rather than having a concentrated hospital market with competitive insurance market, living in an area with extremely and increasing consolidated insurance and hospital market, the patients experience longer stays in the hospital for the same condition.

In addition, because private insurance companies are competing more with their peers rather than public payers, I stratify the samples into public payers (Medicare and Medicaid), private payers including HMOs and others (e.g. self-pay and no charge and others) and investigate the relation between length of stay and market concentration. Equation 7 is estimated using private payer data. Results are comparable to those generated by the OLS model with an interaction term. Table 5 above displays the results in more details. Interestingly, according to similar calculations I do above, this model also implies that, depending on the situation of the counterpart, market concentration of both insurance and hospital markets might harms quality of care. Market concentration improves quality for sure only if the insurance and hospital market concentration are both high. Table 7 describes the thresholds and the consequences of having markets of different consolidation levels. Figure 3 illustrates the change of marginal effect across the thresholds. That means moving away from complete competition, the market concentration starts to harm the quality of care; the marginal effect only turns positive when INS_HHI hits 0.4219 or HMS_HHI reaches 0.5020. In the HCUP NIS 2007 data, only 51,192 observations fall into the overlapped cell where both market structures have positive marginal effect, representing 5.91% of the observations in the dataset. Table 8 describes that LOS and inpatient mortality (DIED) are significantly different (at 0.00 level) between observations fall into the positive cell in figure 3 and those in the other cells. The worse results observed for observations fall into the positive cell implies that, though the market structure starts to improve quality of care when it reaches the turning point (INS_HHI>0.4219 or HMS_HHI> 0.5020 in this case), it cannot compensate the accumulative lost caused by market concentration. Independent group t-test results which include detailed information about Table 8 is attached in the Appendix. This model yields valid instrumental variables which passed the first-stage F-test, Hausman-test and over-identification test. Related statistics of these tests are listed in Table 9. The same patient described above, but who is covered by private plan instead of Medicare, can expect to have 0.5 fewer days stay in hospital, a reduction from 3.5 days to 3 days, if he move from a more competitive market to a less competitive one controlling for all the observables in the model.

$$\ln los_{ij} = \alpha + \beta_1 \widehat{INS\_HHI}_{2007} + \beta_2 \widehat{HMS\_HHI}_{20006} + \beta_3 INS\_HHI_{2007} * HMS\_HHI_{20006} + \beta_4 Female + \beta_5 \text{Age} + \beta_6 Admission_{Type} + \beta_7 PrivatePayer + \beta_8 Urban + \beta_9 Income + \beta_{10} Hosp\_bedsize + \beta_{11} Hosp\_control + \beta_{12} Hosp\_location + \beta_{13} Hosp\_teach + \varepsilon$$ Equation 7

(Instrumental variables: INS_HHI2005, HMS_HHI2003, and INS_HHI2005*HMS_HHI2003)

Table 7: Threshold for positive/negative effect of market structure on quality of care

Effect of market structure on quality of care

	Threshold	**With HHI value greater than the threshold**	**No. and % of obs. in HCUP NIS 2007 fall on right of the threshold**	**With HHI value less than the threshold**	**No. and % of obs. in HCUP NIS 2007 fall on left of the threshold**
Effect of INS_HHI	0.5020 (HMS_HHI)	Positive	156,677(18.08%)	Negative	709,786(81.92%)
Effect of HMS_HHI	0.4219 (INS_HHI)	Positive	237,318(27.39%)	Negative	629,145(72.61%)

Figure 3: Monopoly-monopsony confrontation associated with positive marginal effect
(Market structure has positive marginal effect on quality in areas where both INS-HHI and HMS-HHI are high)

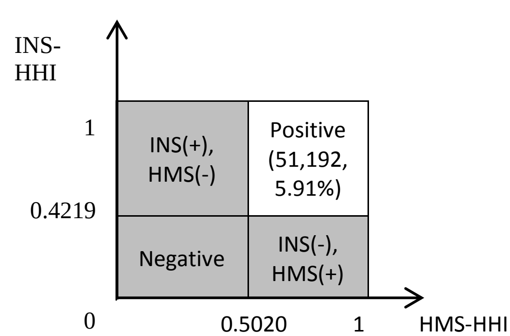


Table 8: Quality of care received by obs. in monopoly-monopsony markets

Compare quality of care received by obs. in monopoly-monopsony(m-m) markets and other markets		
Group/Quality	**los (days)**	**died (percent)**
Others	4.58	1.92%
M-M markets	4.16	2.37%

Table 9: Statistics of IV tests

Statistics of IV validation tests				
	Item	**Value**	**P-value**	**Threshold**
First stage F-test	INS_HHI F-stat	2.3e+05	0.0000	Value>10
	HMS_HHI F-stat	1.1e+06	0.0000	Value>10
Hausman-test	F-stat	181.40	0.0000	P-value<0.05
Overid	Sargan Chi-square	1.45672	0.2275	P-value>0.1
	Basmann Chi-square	1.45667	0.2275	P-value>0.1

SIGNIFICANT BUT NOT SUBSTANTIVE: COMPARE THE OLS RESULTS WITH LITERATURE

The OLS results are comparable to those of the existing literature. Based on a literature review, Vogt and Town (2006) concluded that though results are mixed, concentration of hospital market tends to have a negative impact on quality of care rather than to improve it. (Vogt and Town, 2006) However, recent research on relation between price and insurance market concentration also shows competition leads to better welfare. Signs of coefficients in my results generally align with these studies.

Table 10: Size of impact of HHIs

Size of impact of HHIs changes (from 5% percentile to 95% percentile) on LOS estimated under different models

Model	OLS	OLS with both interaction and quadratic term	2-stage IV regression with interaction terms	2-stage IV regression (Private Plan Only)
Size	7.02%	10.01%	64.38%	13.13%
Size of Impact of INS (Keep HMS Constant)	-3.37%	1.61%	54.96%	23.16%
Size of Impact of HMS (Keep INS Constant)	10.05%	13.66%	2.75%	25.41%

In addition, I compared the size of the associated impact identified by my models with that of major publications after 2000 using similar methods. Table 10 shows the size of impact of hospital market HHI and insurance market HHI respectively holding the other factors constant. Using California Office of Statewide Health Planning and Development (OSHPD) inpatient data (1999-2002) Akosa Antwi et al. (2009) estimated that an increase of 0.1 in the HHI of a hospital market would increase prices (decrease patients' welfare) by 1.9%. Similarly, my research shows that an increase of 0.9 in the HHI of hospital would decrease the length of stay (a measure of patients' welfare) by 13.66. Zwanziger et al. (2000), using OSHPD 1980-1997 data, found a larger impact. This article estimated that a 0.2 difference of hospital HHIs was associated with 5% differences in hospital prices. In addition, a study by Melnick (2007) based on OSHPD 1999-2003 data showed that by moving from the 50^{th} percentile concentration area (HHI=0.5) to an 80^{th} percentile concentration area (HHI=0.37) hospital can charge an extra 13% for inpatient care. The result can be translated into that a 0.13 increase in hospital HHI leads to 13% increase in hospital price, almost about 10 times as much as our findings.

As for insurance HHI, the estimation model most like mine is found in Dafny et al. (2012), which takes a traditional SCP approach and use insurance market HHI to examine the impact of competition on premiums. Dafny finds that a 0-1 change of simulated insurance market HHI is associated with an 18% increase in premiums. But using my OLS estimation with interaction and quadratic terms and holding hospital market HHI constant, a 0.27 increases in insurance HHI is associated with 1.61% decrease in length of stay This result is much smaller than Dafny's finding.

According to Halbersma et al. (2010), both coefficients of insurer market share and hospital market share omitted in my model are positive. That is to say the correlations estimated might have an upwards bias. So the results will be even less substantive if this omitted variable bias is fixed.

MIXED RESULTS CONCERNING INPATIENT MORTALITY

As for the likelihood of dying during an inpatient stay, my study record mixed results. Table 11 is an abstract showing result for key independent variables. A full list is included in the Appendix. In the simplest OLS estimation, a higher concentration level of the insurance market is associated with a positive impact which is translated into a negative outcome. The patient is estimated to be 32% more likely to die in the hospital when the insurance market HHI increases from 0 to 1 (significant at 0.01 level). No significant impact of hospital market concentration is observed. But both the coefficients of the insurance market HHI and the hospital market HHI lose significance after the interaction and quadratic terms are added into the model.

Since an IV probit is more suitable for models with binary outcomes but continuous independent variables, I employ an IV probit to estimate the variable died. In contrast with the OLS model, the IV probit model which included lagged insurance and hospital HHIs together with the interaction terms as instruments for the current values, documents a statistically significant correlation between market structure and inpatient mortality. An increase of insurance market HHI from 0 to 1 is associated with a 38% smaller probability of dying, and increase of hospital market HHI from 0 to 1 is associated with 29% smaller probability of dying. By limiting the number of iterations to keep the time of running this model manageable, the log likelihood concaves but convergence is not achieved. Prob > chi2 equals 0.0000, and Wald test of exogeneity shows that “chi2(2) =5.69” and “Prob > chi2 = 0.0581”. However, the 2-stage OLS IV regression endorses the results of IV probit regression in the sense that sign and significance of results generated by the former are comparable with those generated by the latter.

Table 11: Estimated Coeff. for DIED under different models

Estimated Coeff.

Died in hospital	**Logit**			**Logit with both quadratic and interaction term**			**2-stage OLS IV regression**			**2-stage IV Probit (convergence not achieved)**		
	Coeff.		**s.e.**	**Coeff.**		**s.e.**	**Coeff.**		**s.e.**	**Coeff.**		**s.e.**
INS_HHI2007	0.3267	*	0.1042	0.0058		0.6374	-0.0132	*	0.0048	-0.3784	**	0.1249
HMS_HHI2006	0.0072		0.0391	-0.0711		0.1549	-0.0104	*	0.0026	-0.2934	*	0.0658
INS_HHI2007^2				-0.2841		0.8923						
HMS_HHI2006^2				-0.2342	**	0.1137						
INS*HMS				1.0578	*	0.3228	0.0311	*	0.0080	0.8212	*	0.2010
Control variables							......					
Intercept	-7.1114	*	0.0956	-6.9988	*	0.1558	-0.0096	*	0.0021	-3.1468	*	0.0555
Number of obs.	791936			791936			692184			692184		
Pseudo R2	0.0997			0.0998			0.0159					
Instruments	N/A			N/A			INS, HMS, INS*HMS			INS, HMS, INS*HMS		

* significant at 0.01 level, ** significant at 0.05 level.

The mixed results of market concentration on the possibility of dying in the hospital might reflect two possible situations. For the sickest patient who has high odds of dying no matter what kind of market he is in, death in the hospital happens anyway. The behavior of the hospital and the insurance company might be similar concerning these high-risk patients, while they can manipulate length of stay of those less sick patients in order to secure their profits. The fact that most patients who died during hospitalization are covered by Medicare also supports the argument that both hospital and insurance company have very limited space to manipulate treatment of the sickest people. There’s not much variance between them in terms of how they are treated in hospital probably due to the pay-for-services payment method applied by

Medicare. Table 12 indicates the number of people who died in the hospital in 2007 by primary payers of their hospital bills.

Table 12: Died by Payer

Died During hospitalization	Primary expected payer						
	Medicare	**Medicaid**	**Private**	**Self-pay**	**No charge**	**Other**	**Total**
Not died	699,985	387,552	691,384	106,463	9,850	69,665	1,964,899
Died	25,950	3,186	7,001	1,300	133	1,219	38,789
Total	725,935	390,738	698,385	107,763	9,983	70,884	2,003,688

POLICY IMPLICATIONS

Recent reforms of the U.S. health care delivery system will inevitably increase the hospital market consolidation in both the private and public sectors. 2012 witnesses 109 cases of hospital mergers and acquisitions, increased by 18%. (Modern Healthcare 2013) In addition, with the emergence of ACOs, consolidation of hospital markets might be further exacerbated. However, hospital markets are local. A local hospital will gain monopoly power, only if the merger happens locally. But a regional medical group might not have strong bargaining power in a given local market if there are other local competitors, even if the medical group is large and powerful as a whole. Therefore, it is important to stimulate competition within local hospital markets and to monitor hospital merger cases trying to acquire hospitals in the same medical service area or within the same geographic border. At the meantime, local hospitals should be allowed to join regional hospital chains to improve efficiency and quality through experience and resource sharing and relocation.

As for market concentration in insurance market, the establishment of insurance exchanges might be an opportunity to create a more competitive market place for people to purchase their plans. If the insurance exchanges prove to be competitive and efficient, there might be spill-over effects that force large insurance companies to offer more generous plans to the consumers and more reasonable reimbursement rates to hospitals.

CONCLUSIONS

This study examines the impact of market structure on quality of care, using HCUP NIS 2007 patient discharge data together with hospital and insurance market structure data. I use an SCP model and introduced lagged HHIs are introduced to fix the endogeneity problem. I estimate interaction term of hospital and insurance market structure to determine whether opposite market powers together could yield relatively efficient outcome. I find monopsony-monopoly confrontation is positively related to the change of care quality, but the outcomes experienced by patients are still worse than the outcomes experienced by patients in relatively competitive markets. That is to say, though some models imply that market concentration of one market is positively correlated with the outcome when the value of the other becomes very high, my results suggest generally that competition in health care market is good for improving the quality of care. I suggest that the government should closely monitor anti-competition trends in both of these markets and take actions to prevent further consolidation of insurance companies and hospitals within a single local market.

As I noted in the body of my paper, this paper contributes to the literature in that it uses quality of care instead of price as measure of outcome in a model that includes both insurance and hospital market concentration. It also uses most recent national-wide inpatient data, while most prior studies use regional data from the late 1990s and the early 2000s. However, further research on this topic is needed in the sense that length of stay (LOS) and inpatient mortality (DIED) are not the only and the most precise measures of health care quality. HCUP Patient Safety Indicators, 30-day readmission and 30-day mortality are good alternatives as quality measures. Furthermore, if researcher could leverage longitudinal data, they might obtain more robust conclusion.

APPENDIX

Table 13: Complete list of estimated coeff. for Ln(LOS) Part 1 of 2

Estimated Coeff.

Ln of Length of Stay		OLS			OLS with quadratic term			OLS with interaction term			OLS with both interaction and quadratic term		
		Coeff.		s.e.	Coeff.		s.e.	Coeff.		s.e.	Coeff.		s.e.
INS_HHI2007		0.1205	*	0.0104	-0.3378	*	0.0657	-0.0187		0.0190	-0.3380	*	0.0657
HMS_HHI2006		-0.1077	*	0.0040	-0.2657	*	0.0129	-0.1958	*	0.0104	-0.3224	*	0.0155
INS_HHI2007^2					0.6188	*	0.0898				0.4725	*	0.0919
HMS_HHI2006^2					0.1474	*	0.0112				0.1380	*	0.0113
INS*HMS								0.2808	*	0.0305	0.2133	*	0.0312
Age		0.0049	*	0.0001	0.0049	*	0.0000	0.0049	*	0.0001	0.0049	*	0.0001
1.female		-0.0421	*	0.0018	-0.0420	*	0.0018	-0.0420	*	0.0018	-0.0419	*	0.0018
admission_type													
	2	0.0111	*	0.0027	0.0112	*	0.0027	0.0102	*	0.0027	0.0106	*	0.0027
	3	-0.1424	*	0.0022	-0.1431	*	0.0022	-0.1427	*	0.0022	-0.1432	*	0.0022
	4	-0.0521	*	0.0036	-0.0523	*	0.0036	-0.0522	*	0.0036	-0.0523	*	0.0036
	5	0.1400	*	0.0189	0.1379	*	0.0189	0.1400	*	0.0189	0.1381	*	0.0189
	6	0.4282	*	0.0315	0.4164	*	0.0316	0.4303	*	0.0316	0.4187	*	0.0316
payer													
	2	-0.0767	*	0.0036	-0.0781	*	0.0036	-0.0763	*	0.0036	-0.0777	*	0.0036
	3	-0.1779	*	0.0029	-0.1787	*	0.0029	-0.1779	*	0.0029	-0.1785	*	0.0029
	4	-0.1750	*	0.0045	-0.1763	*	0.0045	-0.1761	*	0.0045	-0.1769	*	0.0045
	5	-0.0991	*	0.0120	-0.1024	*	0.0120	-0.1015	*	0.0120	-0.1037	*	0.0120
	6	-0.1373	*	0.0053	-0.1376	*	0.0053	-0.1365	*	0.0053	-0.1370	*	0.0053
urban													
	2	0.0304	*	0.0025	0.0402	*	0.0026	0.0301	*	0.0025	0.0394	*	0.0026
	3	0.0159	*	0.0031	0.0322	*	0.0036	0.0172	*	0.0031	0.0329	*	0.0036
	4	-0.0084	**	0.0041	0.0020		0.0042	-0.0074		0.0041	0.0024		0.0042
	5	0.0411	*	0.0050	0.0525	*	0.0051	0.0414	*	0.0050	0.0524	*	0.0051
	6	0.0703	*	0.0053	0.0778	*	0.0054	0.0692	*	0.0053	0.0772	*	0.0054
income													
	2	-0.0324	*	0.0024	-0.0341	*	0.0024	-0.0331	*	0.0024	-0.0342	*	0.0024
	3	-0.0509	*	0.0025	-0.0526	*	0.0025	-0.0507	*	0.0025	-0.0521	*	0.0025
	4	-0.0814	*	0.0028	-0.0812	*	0.0028	-0.0803	*	0.0028	-0.0804	*	0.0028
hosp_bedsize													
	2	0.0191	*	0.0031	0.0202	*	0.0031	0.0181	*	0.0031	0.0193	*	0.0031
	3	0.0939	*	0.0027	0.0945	*	0.0027	0.0939	*	0.0027	0.0944	*	0.0027
hosp_control													
	1	-0.0591	*	0.0041	-0.0670	*	0.0042	-0.0637	*	0.0042	-0.0695	*	0.0042
	2	-0.0302	*	0.0030	-0.0373	*	0.0030	-0.0336	*	0.0030	-0.0392	*	0.0030
	3	-0.0407	*	0.0036	-0.0461	*	0.0036	-0.0457	*	0.0037	-0.0492	*	0.0037
	4	-0.1122	*	0.0050	-0.1179	*	0.0051	-0.1171	*	0.0051	-0.1208	*	0.0051
1.hosp_location		0.0838	*	0.0050	0.0841	*	0.0050	0.0833	*	0.0050	0.0841	*	0.0050
1.hosp_teach		0.0382	*	0.0025	0.0361	*	0.0025	0.0358	*	0.0025	0.0347	*	0.0025
intercept		0.9321	*	0.0088	1.0302	*	0.0148	0.9780	*	0.0102	1.0452	*	0.0150
number of obs.		776801			776801			776801			776801		
R-square		0.0809			0.0811			0.0810			0.0812		
instruments		N/A			N/A			N/A			N/A		

Table 14: Complete list of estimated coeff. for Ln(LOS) Part 2 of 2

Estimated Coeff.

Ln of Length of Stay		2-stage IV regression			2-stage IV regression with interaction terms			2-stage IV regression private plan		
		Coeff.		s.e.	Coeff.		s.e.	Coeff.		s.e.
INS_HHI2007		-0.0656	*	0.0164	-14.5364	*	0.7183	-0.5584	*	0.0278
HMS_HHI2006		-0.1180	*	0.0044	-0.5359	*	0.0217	-0.4693	*	0.0152
INS_HHI2007^2					19.9809	*	0.9966			
HMS_HHI2006^2					0.6152	*	0.0223			
INS*HMS					-0.7649	*	0.0749	1.1123	*	0.0464
age		0.0048	*	0.0001	0.0047	*	0.0001	0.0059	*	0.0000
1.female		-0.0447	*	0.0019	-0.0459	*	0.0019	-0.0411	*	0.0019
admission_type										
	2	0.0016		0.0028	-0.0033		0.0028	0.0059		0.0028
	3	-0.1514	*	0.0023	-0.1538	*	0.0024	-0.1484	*	0.0023
	4	-0.0638	*	0.0040	-0.0802	*	0.0042	-0.0275	*	0.0039
	5	0.1299	*	0.0154	0.1156	*	0.0158	0.1139	*	0.0154
	6	0.4324	*	0.0357	0.3933	*	0.0367	0.4425	*	0.0358
payer								-0.1149	*	0.0021
	2	-0.0711	*	0.0037	-0.0786	*	0.0038			
	3	-0.1755	*	0.0029	-0.1837	*	0.0030			
	4	-0.1771	*	0.0047	-0.2020	*	0.0050			
	5	-0.1096	*	0.0116	-0.1810	*	0.0124			
	6	-0.1322	*	0.0055	-0.1211	*	0.0057			
urban										
	2	0.0269	*	0.0026	0.0484	*	0.0028	0.0256	*	0.0026
	3	0.0078	**	0.0033	-0.0623	*	0.0069	0.0103	**	0.0033
	4	-0.0132	*	0.0044	-0.0517	*	0.0058	0.0002		0.0044
	5	0.0439	*	0.0052	0.0198	*	0.0060	0.0476	*	0.0052
	6	0.0677	*	0.0057	-0.0264	*	0.0079	0.0678	*	0.0056
income										
	2	-0.0320	*	0.0026	-0.0738	*	0.0033	-0.0341	*	0.0026
	3	-0.0496	*	0.0027	-0.0888	*	0.0033	-0.0475	*	0.0027
	4	-0.0810	*	0.0029	-0.0818	*	0.0030	-0.0741	*	0.0029
hosp_bedsize										
	2	0.0110	*	0.0035	0.0125	*	0.0036	0.0043		0.0035
	3	0.0898	*	0.0031	0.1028	*	0.0032	0.0902	*	0.0031
hosp_control										
	1	-0.0630	*	0.0046	-0.1717	*	0.0070	-0.0858	*	0.0047
	2	-0.0457	*	0.0034	-0.1245	*	0.0052	-0.0472	*	0.0034
	3	-0.0353	*	0.0039	-0.1635	*	0.0075	-0.0519	*	0.0040
	4	-0.1167	*	0.0059	-0.1544	*	0.0063	-0.1487	*	0.0060
1.hosp_location		0.0587	*	0.0057	0.0039		0.0065	0.0057	**	9.8000
1.hosp_teach		0.0360	*	0.0027	-0.0251	*	0.0040	0.0027	**	10.4000
intercept		1.0364	*	0.0101	3.6926	*	0.1305	1.0875	*	0.0119
number of obs.		679103			679103			679103		
R-square		0.0803			0.0332			0.0774		
instruments		INS, HMS, INSHMS			INS, HMS, INSHMS			INS, HMS, INSHMS		

* significant at 0.01 level, ** significant at 0.05 level.

Table 15: Complete list of estimated coeff. for DIED Part 1 of 2

Estimated Coeff.

Died in hospital		**Logit**			**Logit with quadratic term**			**2-stage IV regression**		
		Coeff.		s.e.	Coeff.		s.e.	Coeff.		s.e.
INS_HHI2007		0.3267	*	0.1042	0.0042		0.6361	-0.0132	*	0.0048
HMS_HHI2006		0.0072		0.0391	0.2055		0.1300	-0.0104	*	0.0026
INS_HHI2007^2					0.4717		0.8567			
HMS_HHI2006^2					-0.1806		0.1122			
INS*HMS								0.0311	*	0.0080
Age		0.0480	*	0.0007	0.0479	*	0.0007	0.0007	*	0.0000
1.female		-0.3293	*	0.0171	-0.3293	*	0.0171	-0.0041	*	0.0003
admission_type										
	2	-0.1662	*	0.0249	-0.1659	*	0.0249	-0.0037	*	0.0005
	3	-0.8026	*	0.0264	-0.8017	*	0.0264	-0.0125	*	0.0004
	4	0.9198	*	0.0709	0.9178	*	0.0709	0.0131	*	0.0007
	5	0.6214	*	0.1097	0.6224	*	0.1097	0.0147	*	0.0026
	6	-2.5326	**	1.0028	-2.5156	**	1.0029	-0.0248	*	0.0062
Payer										
	2	0.4060	*	0.0418	0.4077	*	0.0418	0.0054	*	0.0006
	3	0.2273	*	0.0274	0.2262	*	0.0275	0.0019	*	0.0005
	4	0.3386	*	0.0539	0.3386	*	0.0539	0.0011		0.0008
	5	0.2285		0.1407	0.2286		0.1407	-0.0017		0.0020
	6	0.7079	*	0.0472	0.7096	*	0.0472	0.0068	*	0.0009
Urban										
	2	0.0483		0.0255	0.0336		0.0270	0.0010	**	0.0004
	3	0.0336		0.0309	0.0023		0.0356	0.0010		0.0006
	4	0.2121	*	0.0395	0.1915	*	0.0413	0.0048	*	0.0008
	5	0.2788	*	0.0454	0.2563	*	0.0473	0.0051	*	0.0009
	6	0.2412	*	0.0486	0.2201	*	0.0503	0.0036	*	0.0010
Income										
	2	-0.0497	**	0.0241	-0.0508	**	0.0243	-0.0003		0.0005
	3	-0.0481		0.0249	-0.0487		0.0250	0.0000		0.0005
	4	-0.1213	*	0.0281	-0.1209	*	0.0281	-0.0009	**	0.0005
hosp_bedsize										
	2	-0.0748	**	0.0322	-0.0763	**	0.0322	-0.0015	**	0.0006
	3	0.0890	*	0.0284	0.0893	*	0.0284	0.0009		0.0005
hosp_control										
	1	-0.1224	*	0.0442	-0.1184	*	0.0449	-0.0031	*	0.0008
	2	0.0305		0.0300	0.0365		0.0305	-0.0007		0.0006
	3	-0.0633		0.0354	-0.0608		0.0358	-0.0030	*	0.0007
	4	-0.1439	*	0.0527	-0.1428	*	0.0531	-0.0036	*	0.0010
1.hosp_location		0.1869	*	0.0470	0.1829	*	0.0471	0.0010		1.9400
1.hosp_teach		0.1391	*	0.0247	0.1387	*	0.0249	0.0005	*	3.9700
Intercept		-7.1114	*	0.0956	-7.0741	*	0.1545	-0.0096	*	0.0021
Number of obs.		791936			791936			692184		
Pseudo R2		0.0997			0.0997			0.0159		
Instruments		N/A			N/A			INS, HMS, INS*HMS		

Table 16: Complete list of estimated coeff. for DIED Part 2 of 2

Estimated Coeff.

Died in hospital		**Logit with interaction term**			**Logit with both quadratic and interaction term**			**2-stage IV regression (convergence not achieved)**		
		Coeff.		s.e.	Coeff.		s.e.	Coeff.		s.e.
INS_HHI2007		-0.1779		0.1936	0.0058		0.6374	-0.3784	**	0.1249
HMS_HHI2006		-0.2994	*	0.1048	-0.0711		0.1549	-0.2934	*	0.0658
INS_HHI2007^2					-0.2841		0.8923			
HMS_HHI2006^2					-0.2342	**	0.1137			
INS*HMS		0.9687	*	0.3061	1.0578	*	0.3228	0.8212	*	0.2010
age		0.0479	*	0.0007	0.0479	*	0.0007	0.0192	*	0.0003
1.female		-0.3290	*	0.0171	-0.3290	*	0.0171	-0.1379	*	0.0078
admission_type										
	2	-0.1700	*	0.0249	-0.1701	*	0.0249	-0.0807	*	0.0115
	3	-0.8045	*	0.0264	-0.8033	*	0.0264	-0.3431	*	0.0113
	4	0.9187	*	0.0709	0.9178	*	0.0709	0.4167	*	0.0256
	5	0.6207	*	0.1097	0.6221	*	0.1097	0.2986	*	0.0492
	6	-2.5286	**	1.0028	-2.5081	**	1.0028	-0.9226	**	0.3141
payer										
	2	0.4057	*	0.0418	0.4085	*	0.0418	0.1714	*	0.0169
	3	0.2267	*	0.0275	0.2268	*	0.0275	0.0912	*	0.0115
	4	0.3344	*	0.0539	0.3353	*	0.0539	0.1309	*	0.0221
	5	0.2170		0.1407	0.2193		0.1406	0.0793		0.0549
	6	0.7121	*	0.0472	0.7142	*	0.0472	0.2382	*	0.0221
urban										
	2	0.0449		0.0255	0.0268		0.0270	0.0276		0.0111
	3	0.0381		0.0309	0.0052		0.0355	0.0345		0.0141
	4	0.2166	*	0.0396	0.1946	*	0.0412	0.1165	*	0.0183
	5	0.2808	*	0.0454	0.2569	*	0.0472	0.1396	*	0.0211
	6	0.2396	*	0.0487	0.2197	*	0.0503	0.1216	*	0.0229
income										
	2	-0.0528	**	0.0241	-0.0515	**	0.0243	-0.0148		0.0110
	3	-0.0471		0.0249	-0.0452		0.0250	-0.0100		0.0112
	4	-0.1165	*	0.0280	-0.1156	*	0.0281	-0.0430	**	0.0125
hosp_bedsize										
	2	-0.0765	**	0.0323	-0.0782	**	0.0323	-0.0200		0.0152
	3	0.0911	*	0.0285	0.0910	*	0.0285	0.0447	**	0.0137
hosp_control										
	1	-0.1401	*	0.0447	-0.1324	*	0.0451	-0.0788	*	0.0203
	2	0.0174		0.0302	0.0256		0.0305	-0.0140		0.0142
	3	-0.0823	**	0.0360	-0.0777	**	0.0362	-0.0547	**	0.0168
	4	-0.1643	*	0.0533	-0.1600	*	0.0535	-0.0991	*	0.0251
1.hosp_location		0.1860	*	0.0471	0.1843	*	0.0472	0.0580	**	0.0230
1.hosp_teach		0.1296	*	0.0249	0.1304	*	0.0250	0.0636	*	0.0113
intercept		-6.9443	*	0.1101	-6.9988	*	0.1558	-3.1468	*	0.0555
Number of obs.		791936			791936			692184		
Pseudo R2		0.0997			0.0998			N/A		
Instruments		N/A			N/A			INS, HMS, INS*HMS		

Table 17: Compare means of los and died by markets structure

Two-sample t-test with equal variances (Compare means of los and died of obs. in monopoly-monopsony (m-m) markets and other markets)

	Group	**# of Obs.**	**Mean**	**Std. Err.**	**Std. Dev.**	**[95% Conf. Interval]**	
los	Others	1957198	4.57948	0.00494	6.910801	4.569799	4.589162
	M-M markets	51191	4.158192	0.022948	5.192156	4.113213	4.203171
	Combined	2008389	4.568742	0.00485	6.872655	4.559237	4.578247
	Ha: diff!=0, Pr(|T|>|t|=0.0000						
	Group	**# of Obs.**	**Mean**	**Std. Err.**	**Std. Dev.**	**[95% Conf. Interval]**	
died	Others	1956868	0.01925	9.82E-05	0.137401	0.019057	0.019442
	M-M markets	51192	0.023734	0.000673	0.152221	0.022416	0.025053
	Combined	2008060	0.019364	9.72E-05	0.137801	0.019173	0.019555
	Ha: diff!=0, Pr(|T|>|t|=0.0000						

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